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OFFICE OF STRATEGIC SERVICES
Research and Analysis Branch

097.3
Z1092
No. 1748

R and A No. 1748

THE GERMAN LONG-RANGE ROCKET PROJECTILE

A summary and analysis of available intelligence on German long-range rocket projectiles, together with an hypothesis as to the fuel used in propulsion.

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4 January 1944

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SUMMARY AND CONCLUSIONS

1. German experiments with rocket weapons have probably resulted in the development of a projectile of great size and range. The most authentic report places its length at 7-8 meters (23-26 feet), its weight at 6 (metric?) tons (6.5 short tons), and its range at 315 kilometers (200 miles).

2. Some of the experiments have employed a wheeled car on a sloping ramp for launching, but the reports suggest experimentation with other methods.

3. It is not known whether remote-control devices have been perfected which cannot be jammed.

4. Large supplies of tail gases from synthetic oil plants are available and may constitute a supply fuel for propulsion (or possibly material for the explosive charge).

5. Although rocket propulsion is a relatively cheap method of delivering large loads of destructive materials, it has several disadvantages:

   a. A large portion of the projectile must be devoted to the propellant and its mechanism.

   b. Without control, it is inaccurate, but radio-controls may possibly be jammed;

   c. Its emplacements are vulnerable to air attack.

6. The most probable purpose of the rocket projectile is the disruption of invasion preparations.

7. The many intelligence reports on the long range rocket projectile are largely contradictory, and with few exceptions vague.

THE GERMAN LONG-RANGE ROCKET PROJECTILE

I. SCALE OF ATTACK: FUEL

The attention of the Office of Strategic Services, was first drawn to the possible scale of operations of the long-range rocket -- reported to be the German "secret weapon" -- by the peculiar situation revealed by its study of tail gases of synthetic oil plants, (principally butane and propane).[1] Although production of butane and propane in 1943 amounted to 1,400,000 metric tons, known types of consumption amounted to less than 800,000 tons, leaving 600,000 tons for unknown uses.

Under such circumstances, the natural expectation would have been a German program for the encouragement of the use of these gases as motor fuel in the form of "bottled gas." Such encouragement was indeed given in the early phases of the war. In September 1942, however, special restrictions were imposed upon the use of liquid gas for motor fuels in spite of the fact that the need for motor fuels at this time was very great relative to the supply. Furthermore, recent references to the gases in the German technical press indicate that they may be broadly used after the war for motor fuel and industrial purposes, but that during the war they have special war uses and are now completely utilized.

The chemical and physical characteristics of the products

1. The existence of a secret weapon is assumed in this paper. The possibility cannot be entirely dismissed, however, that German experiments have failed, and that the secret weapon has become merely a propaganda weapon, aimed either at German or Allied morale, or both.

that can be derived from these gases are such that their use as the propellant of rocket projectiles is quite possible.

Several independent reports have been received indicating that these gases and their derivatives are indeed used in conjunction with Germany's secret weapon. It is impossible, however, to evaluate the reliability of these reports.

If they are correct, the planned scale of operation would indeed be tremendous. On the other hand, the supply of TNT and other high explosives would limit the amount that could be devoted to the charge of rocket projectiles to a scale smaller than would be permitted by the hundreds of thousands of tons of tail gases available. Even so, the use of TNT or amatol in rocket attacks might permit a scale of attack considerably larger than that possible by aerial bombardment, if the other problems of rocket projection could be solved. It is also possible that alternative explosives of new destructive power have been devised for use in connection with the new projectile, or that it might be charged with incendiary materials. It has even been suggested in one intelligence report that products of tail gases are to be used both as explosive charge and as fuel for the long-range rocket weapon.

II. INTELLIGENCE CONCERNING THE LONG-RANGE ROCKET

A. General

Reliable information concerning the long-range rocket itself is extremely scarce. Rumors concerning this weapon, many or most of them Nazi inspired, are common in Germany and in neutral and occupied Europe, but these are usually vague or obviously extravagant. Most prisoners of war have little information aside from the usual rumors.

Certain basic facts, however, are clear. Germany has for a long time been intensely interested in rocket projectiles, and many experiments have been carried out. These experiments have resulted in the development of numerous types of rocket projectiles, among them the six-barrelled "Nebelwerfer," or rocket mortar, which has seen use on active fronts for many months; the air-borne rocket used against bomber formations; rocket anti-aircraft artillery; and many other rocket types. It is likewise clearly established that much work has been done on long-range rockets, frequently referred to as aerial torpedoes.

A second line of German development has been radio-control or radio-guidance of projectiles. This development has led to the FX type of aerial bomb, and the Hs 293 glider bomb, both of which have been used with varying success against Allied shipping.

A third line of German experimentation has focussed on the search for new explosives, especially explosives based upon the release of atomic energy.

The major question is whether and to what extent these lines of development have been brought together into a single effective

weapon --a giant rocket which is guided (either by radio or other remote control), or is charged with new explosive force, or both.

The most detailed reports on the long-range rocket are based on interviews with a prisoner of war who claims to have operated the Würzburggeraet (radar) used to measure the distances attained in tests of the long-range projectile at the experimental center of Peenemunde, where the FX and Hs 293 were also developed.

These tests were conducted in February and March 1943, and the rockets were fired into the Baltic Sea. The P/W said that they attained a maximum distance of 315 km., and that they were shot at a rate of 1 every 3 minutes.

At Peenemunde there were said to be 12 stadium-like ovals, each 100 meters long. Within each oval there were 4 tracks, 2 meters wide, upon which 4 axelled rocket-projecting cars were placed. Although the report of the interrogation is confused, there were apparently bunkers in the floor of the oval, surrounded by concrete walls, from which tracks led to the upper edge of the oval. Each stadium also had a tower, 25-30 meters high.

The rocket used in these experiments was described as being 7-8 meters long, weighing about 6 tons, with steering fins, and openings in the rear for rocket propulsion. The truck and its rocket were brought into the stadium and the first charges set off, causing the truck and rocket to shoot toward the upper rim, at which point the truck was caught and rocket continued on its course. The initial speed of the rocket was estimated at 400 kms.,

and its average velocity 800 kms., per hour.

Other sources of information to some extent confirm the picture presented by this prisoner, but there is no single point of information upon which all or even many of the sources are in agreement.

B. Launching

While none of the various other reports refers to a stadium-like structure of the type described by the prisoner of war, a large number mention a sloping ramp, often connected with an underground tunnel, roughly similar to some of the "constructional works" photographed in northern France. Other reports mention grenade-throwers, catapults, tubes, or mortars, which also could be used with rocket propulsion, while still others speak of towing into the air by aircraft. The divergence among the reports may indicate that experiments were made with various methods of launching.

OSS has recently received from the Air Ministry a number of photographs of what are presumed to be secret-weapon installations, in northern France. These areas, of varying size and shape, contain two or three structures, about 250 feet long, which resemble "skis" lying on edge whose main axes are alligned in apparently haphazard fashion; 2 or 3 relatively small rectangular buildings, one of which often has a pyramidal hole near it; and in some instances a small platform. The positions of these various structures relative to each other are not fixed.

With the exception of a set of targets photographed in October these "construction works" do not conform to the lay-out suggested in the P/W report.

C. Control

It is interesting to note that the prisoner of war who described the Peenemunde experiments, made no mention of any control mechanism, other than an initial setting of the steering fins. That the problems of remote control can be solved is demonstrated both in the FX and the Hs 293 bombs (also developed at Peenemunde), as well as in the "Benito" and "Ruffian" devices used by German aircraft in early bombing missions against England. While jamming efforts directed against the FX and Hs 293 have so far been unsuccessful, due largely to the short interval of flight, jamming of directed bombing missions was so effective that they were quickly abandoned

On the other hand, a number of other intelligence reports do refer, one in some detail, to remote control. Several reports even recognize the vulnerability of ordinary radio controls to jamming and refer to new controls that allegedly cannot be jammed -- one magnetic, another infra-red. There can be no doubt that much German effort has been devoted to the problem of control, but whether the problem has been solved cannot be determined. In the absence of controls, rocket projectiles are notably inaccurate. Gyroscopic stabilizers are mentioned in one report, while others state that accuracy of within 1000 yards has been achieved.[1]

1. A new report, dated 31 December 1943, just received, refers to the careful effort made to exclude any metal particles from the concrete emplacements under construction in northern France. It also refers to an apparatus on the emplacement containing a quartz crystal, suggesting fixed-frequency radio control.

D. Propulsion and Charge

It has already been noted that tail gases from synthetic oil production are available in large quantity either for fuel or charge or both. The following propellants have been specifically referred to in ground reports:

pure alcohol
hydrogen
butane, nitric (or nitrous) acid, and acetaldehyde
benzine and oxygen
"liquid air"
salt peter and gas-oil under pressure of 50 atmospheres
compressed air and petroleum
diglykol (used in small rockets)

Enthusiastic reports of all sorts are in circulation concerning the enormously destructive effects of the rocket, including a number of intimations of a new explosive with tremendous blast effect. There is only occasional mention of atomic explosives, and of gas, while a few reports mention liquid air (which could mean a liquified gas, either as propellant or charge), and several refer to phosphorous or other incendiary materials. As noted, one report refers to an explosive charge of propanein or propylenein, apparently garbled names of derivatives of tail gases.

APPENDIX: SUMMARY OF INTELLIGENCE

The following table presents summaries of the more interesting intelligence reports on the German long-range rocket. The wide variation in detail is the most noteworthy feature of these reports.

Characterization	Method of launching and emplacement	Length	Diameter	Weight	Control	Propulsion and fuel	Charge	Range	Source
Compressed air bomb				1000 kg.			(Compressed air, flattens everything within 200 miles.		P/W
									P/W
Rocket-no wings				16,400 kg.	Remote controlled by short waves				
Rocket				1800 kg.			(Highly concentrated incendiary; 500 enough to turn London to heap of ashes		Polish Intelligence
							Air pressure kills everything within 5 km.		S.I.
	Giant grenade thrower							Able to shell London	S.I.
Long-range gun	28 shells capacity							Over 200 km. deviation less then .5 percent.	S.I.
Rocket	Tube	3 m.	60 cm.	2000 kg.		(Propellant occupies 4/5 of volume salt peter and gas-oil under 50 atmospheres			
							Burning liquid, phosphorous, or gas	175-200 kmg.	S.I.
Rocket shell	Tube, 18 m. long		90 cm.	2000 kg.					
							Gas, naptha, phosphorous, or HF	200 km.	S.I.
Rocket gun	Tube, 20-40 m. long		80-100 cm.						
Robot plane				3600 kg	(Controlled by electromagnetic waves			300 km.	Polish Intelligence

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Characterization	Method of launching and emplacement	Length	Diameter	Weight	Control	Propulsion and fuel	Charge	Range	Source
Jet-propelled bomb	Shot from light mortars by jet propulsion			5-6 kg. (may be charged)					Military Attache
Rocket Bomb	Huge channel			36000+ 13,500 as propellant			Liquid air damage 8 sq. km. 2 would obliterate London	500 km.	P/W
Liquid rocket		5-6 m.				Colossal temperatures arise	Charge same as good torpedo	Long distance-use on fleets	P/W
Gun	40 m. runways (at P)						Crater 8 km. in diameter Killed persons in radius of 40 km.		P/W P/W
Bomb with tail		7-8 m.(tail)		16,400 kg.					S.I.
Air torpedo with 1 m. wings and small tail wings	Sloping runway, 30 m. wide, 2-3 km. long	5 m.							S.I.
Submarine rocket torpedo mine		25 m.	70 cm.		Steered by radio				S.I.
Rockets	Steam powered launching mechanism	12-15 m.		8500 with 2700 explosive	Radio-u-	Butene, acetaldehyde or burning in presence of nitric or nitrous acid	Propylene in or propane in	220-230 km.	S.I.
Plane, 4-5 m. wing span		7 m.				Benzine and oxygen	1,000 kg. highly concentrated HE	"Great distances"	S.I.
Rocket gun	Sloping ramp			85,000				60-70 km.	P/W
Rocket-seamless forged steel cylinder	No barrel			70,000 kg	Equipped with gyroscope; electrically aimed, fired along DF beam	Hydrogen		1500-1800 km.	P/W
Rocket	Railway rail			6,500 kg. (medium size)				60-100 km.	P/W

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Characterisation	Method of launching and emplacement	Length	Diameter	Weight	Control	Propulsion Charge and fuel	Range	Source
Rocket (3 sizes)		16 m. (medium size)		6,500 kg. (medium size)	Radio-controlled	Acetaldehyde, butane, HNO_3	(Small size 230 km. (Medium 45 km.	Military Attache
Aerial torpedoes						Mixture compressed air and petroleum		P/W
Rocket	Launched by catapult				Steered by magnetic principle, with compensation for stratospheric disturbances	Rocket powder	Could hit London	S.I.
Small rocket, used for propaganda distribution, captured in Italy						Diglykol		M.I.S.
Rocket projectiles						500,1,200, 5,000 horse-power turbines		G.I. O.N.I.
Aerial torpedo	Initial impulse by mortar or mortar-like arrangement						Great accuracy not obtainable 180 km.	